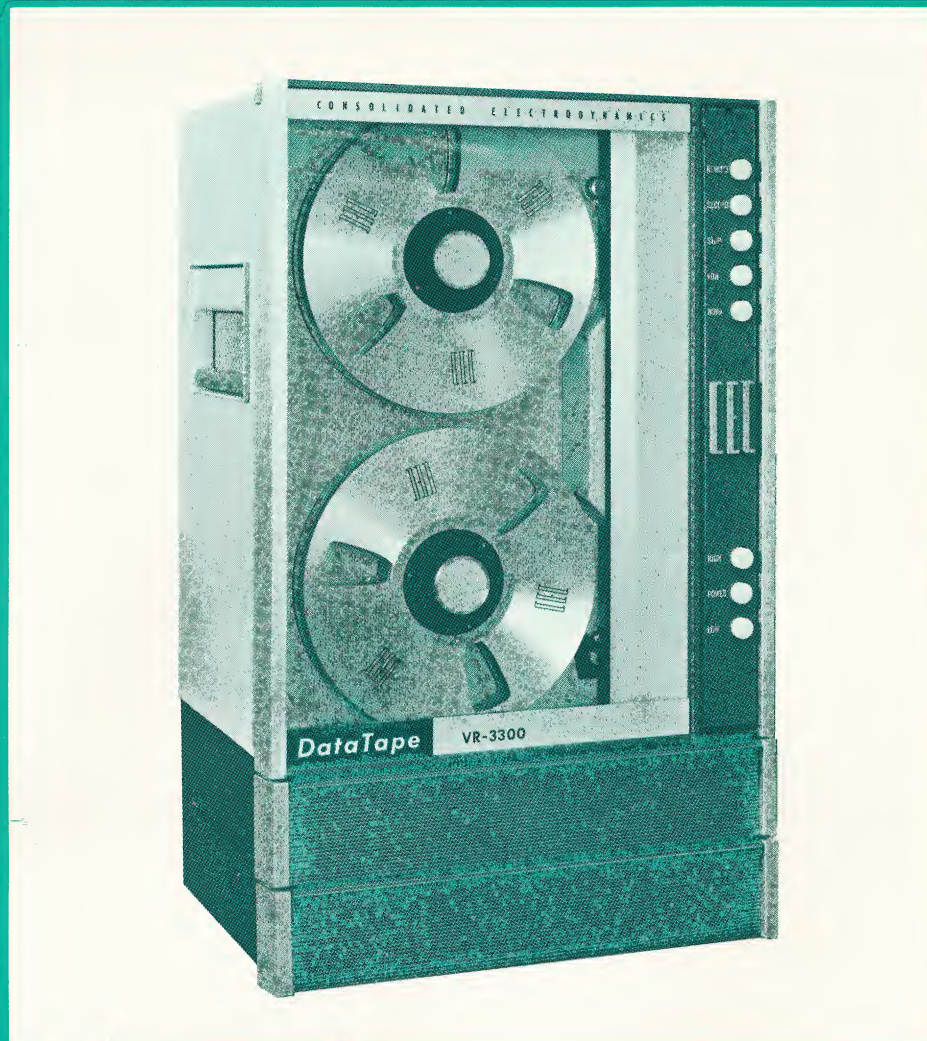
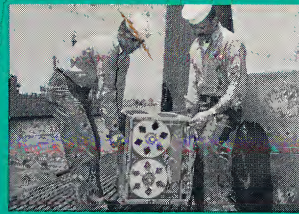


VR-3300 MAGNETIC TAPE RECORDER / REPRODUCER



CEC

DATA RECORDERS DIVISION

CONSOLIDATED ELECTRODYNAMICS A SUBSIDIARY OF BELL & HOWELL

VR-3300 MAGNETIC TAPE RECORDER/REPRODUCER

FEATURES:

*Wide Bandwidth and Portability • Six Speeds • All Solid-State • Plug-in Electronics
All Metal Front Surface Heads • Automatic End-of-reel Stop • Backlighted Mode Controls • Dynamic Braking*

DESCRIPTION

Consolidated's VR-3300 Magnetic Tape Recorder/Reproducer is a wideband system for use in applications where portability is desirable. The instrumentation-class recorder provides true laboratory performance in instrumentation vans, aboard ships and submarines, and when moved from lab to lab. Bandwidth of direct recording/reproducing is 100 cps to 200 kc; 0-20 kc with wideband FM techniques. This represents twice the bandwidth of standard telemetry recorders—or top performance at minimum cost. Standard PDM electronics are also offered.

The complete 14-channel record and reproduce system can be utilized as a single portable system 29 $\frac{3}{8}$ inches high weighing approximately 213 pounds. Optional fixed or slide mounting hardware allows mounting the recorder in a standard EMA rack. Tape widths of $\frac{1}{2}$ inch or 1 inch are accommodated by the transport for 7- or 14-channel applications, respectively. Backlighted pushbuttons control all operating modes and are electrically interlocked to allow any sequence of selection without possibility of tape damage. Solid-state electronics, and proven circuit designs using components with high ratings insure reliability and long life.

POWER REQUIREMENTS

Input power requirement of the system is 115 volts $\pm$ 10 volts, 60 cps single phase. Power consumption is approximately 500 watts for the complete 14-channel system, or 450 watts for the 7-channel system. CEC's Precision Frequency Power Supply is the recommended power source for the recorder/reproducer capstan motor. This high-stability power unit eliminates the effects of variations in line voltage and frequency on the capstan motor and provides a steady tape speed throughout the range of the system. Input voltage can be either of the following: 105 to 125 volts a-c, 48-65 cps, single phase; 210 to 250 volts a-c, 48-65 cps, single phase; +22 to +26 volts d-c or +26 to +32 volts d-c (by appropriate connector plug-in). This unit allows system operation from any of these power line sources.

ALL SOLID-STATE ELECTRONICS

Record and reproduce amplifiers are mounted on printed circuit, plug-in epoxy cards and are fully transistorized. Plug-in transistors provide for easy maintenance. The amplifier mounting assemblies, which house and provide all electrical connections for the amplifiers plus power regulators and bias oscillator (if required), bolt to the bottom of the transport carrying case in portable applications.

Direct record and reproduce amplifier circuits utilize constant-current recording techniques with high frequency (1.0 MC) bias and system frequency response equalization in the reproduce process. The FM system employs magnetic core multivibrator circuitry and saturation recording with frequency doubling and pulse counting discriminator tech-

niques in the reproduce process. PDM electronics differentiate and amplify rectangular input signals for recording. The reproduced signal is amplified and reconstructed for presentation of a rectangular signal similar to the system input signal during reproduce. Automatic resetting of the reproduce system for missing pulse or tape dropout protection is provided. All necessary power for system electronics, 7- or 14-channel, is derived from the transport power supply and regulated within the amplifier mounting assemblies. Electronics are interchangeable with CEC's VR-2800 system.

UNIFORM TENSION TYPE DRIVE

The capstan drive system of the VR-3300 is unique. Flexibility of an open-loop drive's head stack arrangement is provided, while the performance characteristics of a closed-loop drive system are retained. A dual capstan drive system assures uniform tape tension within the head loop and provides maximum reel isolation. Tape lifters minimize head wear by lifting tape from the heads during fast wind or rewind.

TAPE SPEEDS

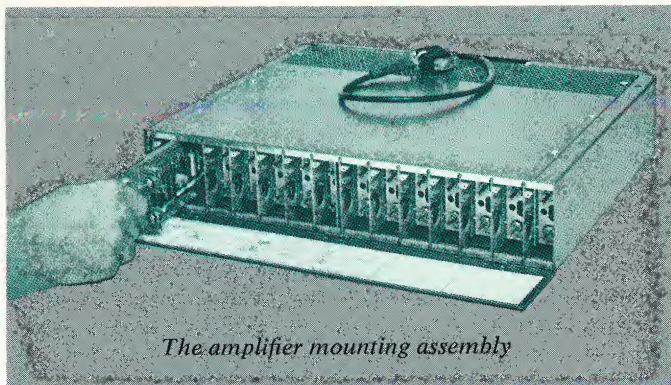
Six standard speeds in three pairs (60, 30 ips; 15, 7 $\frac{1}{2}$ ips; and 3 $\frac{3}{4}$, 1 $\frac{7}{8}$ ips are set up by means of a simple belt and switch change. High-low pushbuttons on the VR-3300's front panel permit electrical selection of either speed in the pairs indicated.

ALL-METAL-SURFACE MAGNETIC HEADS

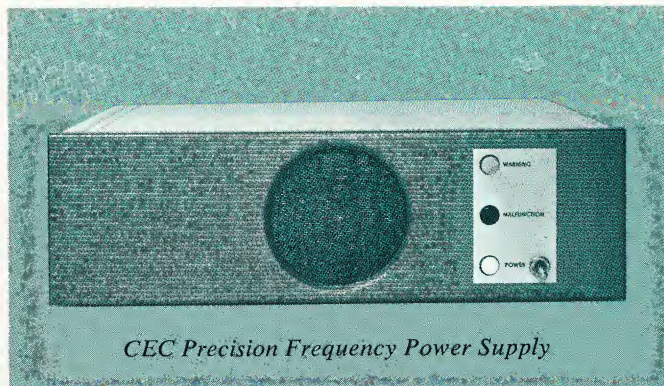
Consolidated's magnetic record and reproduce heads feature precision construction and long-life characteristics. Metal-to-metal construction is used exclusively. The finely honed surface of the head stack minimizes oxide buildup. Separation losses between tape and head are minimized by CEC's design; and improved high-frequency response in the system results. Head stacks mount directly on a flat precision plate, with no shims, adjustments, or special alignment procedures needed. Standard CEC head stacks have 7-, 4-, and 3-track configurations for 1 inch and $\frac{1}{2}$ inch tape width application.

VR-3300 RECORDING TIME:

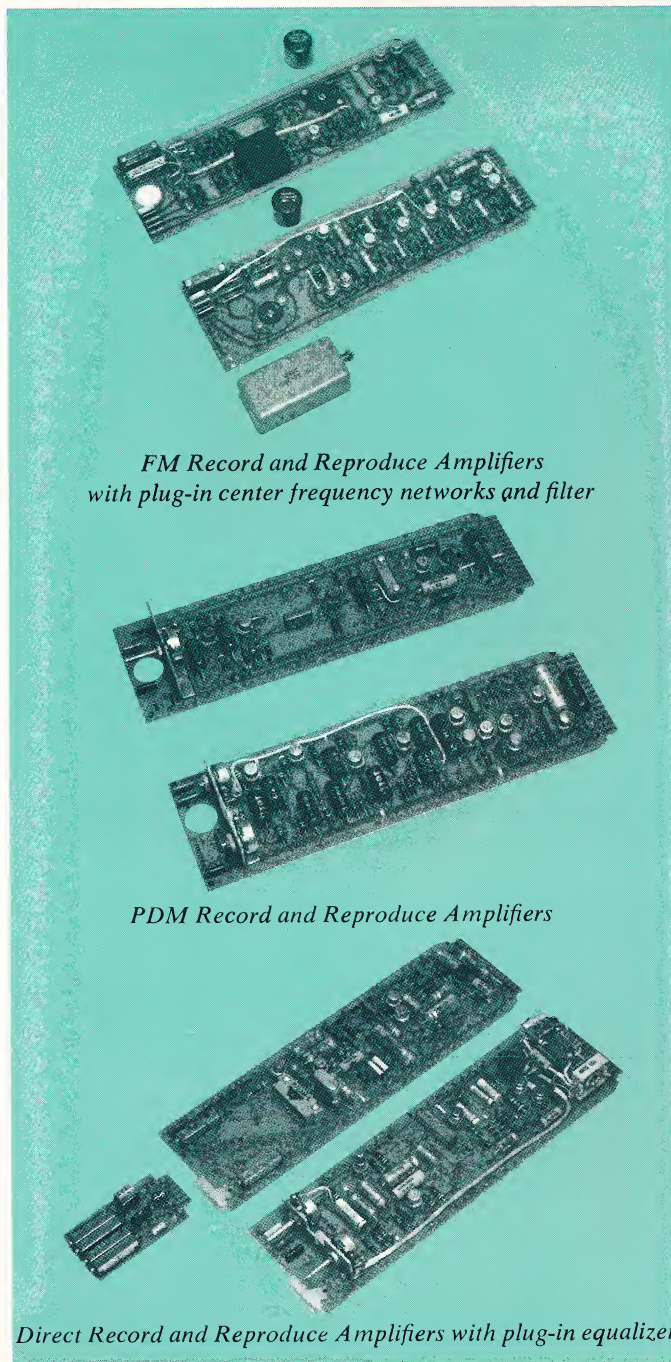
TAPE SPEED	FREQUENCY RANGE (MAX)		RECORDING TIME	
			10 $\frac{1}{2}$ INCH REEL	
	Direct Electr.	FM Electr.	1.0 Mil Tape	1.5 Mil Tape
60 ips	.1 to 200 kc	d-c — 20 kc	12 min.	8 min.
30 ips	.1 to 100 kc	d-c — 10 kc	24 min.	16 min.
15 ips	.1 to 50 kc	d-c — 5 kc	48 min.	32 min.
7-1/2 ips	.1 to 25 kc	d-c — 2.5 kc	1 hr. 36 min.	1 hr. 4 min.
3-3/4 ips	.1 to 12 kc	d-c — 1.25 kc	3 hr. 12 min.	2 hr. 8 min.
1-7/8 ips	.1 to 6 kc	d-c — .625 kc	6 hr. 24 min.	4 hr. 16 min.



The amplifier mounting assembly



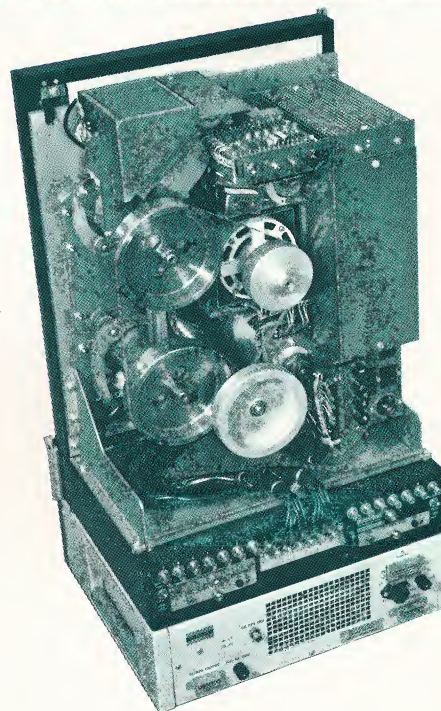
CEC Precision Frequency Power Supply



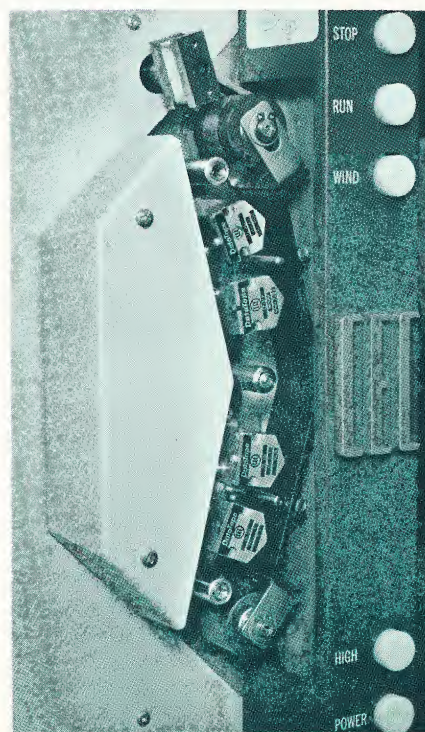
*FM Record and Reproduce Amplifiers
with plug-in center frequency networks and filter*

PDM Record and Reproduce Amplifiers

Direct Record and Reproduce Amplifiers with plug-in equalizer



VR-3300 with cover off

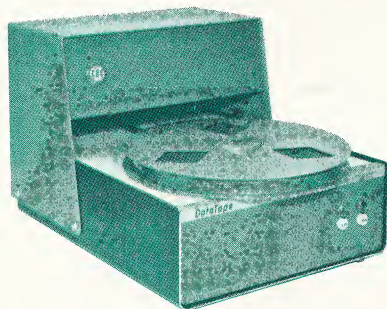


*View shows magnetic head area
of the recorder/reproducer*

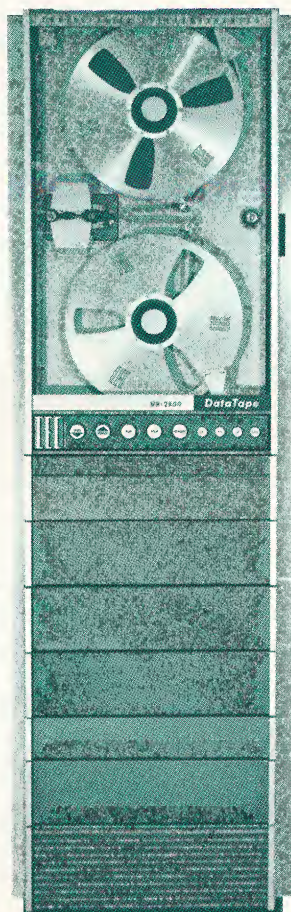


ACCESSORIES AVAILABLE

CEC is the sole distributor of a complete line of Magnetic Instrumentation Tape manufactured by Eastman Kodak Company. The tape is recommended for use with all CEC recorder/reproducers. It is the first tape designed to be entirely compatible with today's advanced instrumentation, enabling modern tape equipment to deliver its full potential. For specifications and prices, send for Bulletin 1652.



Automatic Tape Degausser bulk erases 1/2 inch and 1 inch magnetic tape to a nominal 90 db below saturation level; accepts reels from 7 to 14 inches in diameter and tape widths from 1/4-inch to 2-inch television tapes. Degausser is available for bench or rack mount. Bulletin 2903.



The amplifier cards used in the Type VR-3300 can also be used in CEC Type VR-2800 Recorder/Reproducer. Bulletin 2800V.

Fixed or Slide Rack Mounting Kits
Magnetic-Head Track Patch Panel
Remote Control Unit
Magnetic-Head-Track-Switch Panel
Signal Monitor Meters and Attenuators
for Record and Reproduce Amplifiers
Input/Output Signal Patch Panel
Bin Loop Adapter



CEC's new precision, long-life magnetic heads feature a newly designed face configuration. Higher unit-area tape pressure results in radical reduction of dropouts; improved output characteristics, especially at high frequencies, greater track-to-track uniformity. The new heads are in accordance with applicable paragraphs of IRIG Specifications 106-60.

NOTE: All specifications subject to change without notice. All specifications based on using standard CEC test procedures.

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Dallas, Texas
433 Regal Row

Denver, Colorado
2120 S. Birch Street

Des Plaines, Illinois
3150 Des Plaines Avenue

Hampton, Virginia
1120 W. Mercury Blvd.

Hasbrouck Heights, N.J.
345 Boulevard

Houston, Texas
5405 Griggs Road

Huntsville, Alabama
3322 S. Memorial Parkway

Los Altos, California
900 N. San Antonio Road

Needham Heights, Mass.
45 Fourth Avenue

New Orleans, Louisiana
1025 S. Jefferson Davis
Parkway

Philadelphia, Pennsylvania
2010 Oregon Avenue

Pomona, California
675 North Park Avenue

Salt Lake City, Utah
48 E. Robert Avenue

St. Louis, Missouri
1401 Brentwood Boulevard

Seattle, Washington
302 Second Avenue, West

Syracuse, New York
Pickard Building, Room 162
Malloy Road

Van Nuys, California
5430 Van Nuys Blvd.

Winter Park, Florida
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**Consolidated Electrodynamics
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Woking, Surrey, England

GENERAL SPECIFICATIONS

VR-3300 MAGNETIC TAPE RECORDER / REPRODUCER SYSTEM

TRANSPORT

Tape Speeds: Six standard speeds in 3 pairs (60, 30 ips; 15 7½ ips; and 3¾, 1⅞ ips) are set up by means of a simple belt and switch change. HIGH-LOW pushbuttons on the VR-3300's front panel permit electrical selection of either speed in the pairs indicated.

Tape Speed Accuracy: $\pm 0.25\%$ (with capstan motor operated from Precision Frequency Power Supply) or a 60 cps power line with frequency accuracy of $\pm 0.01\%$.

Tape Dimensions: ½- or 1-inch wide. All transports accept either 1- or 1.5-mil mylar base tape.

Reels Accommodated: 10½ inch diameter with EIA hub. CEC precision reels are supplied as standard equipment. All specifications are based on use of CEC precision reels and CEC recommended tape.

Controls: Backlighted pushbuttons on vertical control panel for: WIND, REWIND, STOP, RUN, RECORD, POWER, HIGH SPEED & LOW SPEED. WIND, REWIND, STOP, RUN, and RECORD are relay operated to permit remote control. Remote control connector is located on the tape transport.

Stop, Start, and Rewind Times: (115 volts a-c power) The fast forward and rewind speeds are nominally the same. A full 10½ inch reel of 1.5-mil base tape (2400 ft) can be shuttled in approximately 2 minutes (2½ minutes maximum). Capstan control of the tape in record or reproduce mode is achieved in less than 3 seconds at a speed of 60 ips and 2 seconds at lower speeds. Tape can be stopped in less than 2 seconds at 60 ips and 1 second at all other capstan controlled speeds.

Fail Safe: Tape stops on 2 ft of clear leader at the end of tape if tape breaks or on power failure without spilling tape.

Flutter: Maximum cumulative flutter up to 300 cps—0.3% peak-to-peak; up to 10 kc—0.55% peak-to-peak (at 60 ips tape speed).

The system has been designed for use in a laboratory environment where shock, vibration, salt atmosphere, and excessive sand and dust are not encountered. The equipment has been found suitable for use in trailer installations while stationary and on shipboard where laboratory conditions are maintained. The equipment is transportable in trailers when suitably mounted and packaged.

Weight: A complete 14-channel system including tape and full amplifier complement weighs 213 lbs maximum (7 channel—186 lbs). Add 90 lbs for systems including Precision Frequency Power Supply.

Operating Power Requirements: Tape transport and record/reproduce electronics operate from 115 v a-c $\pm 10\%$, 48-65 cps, single-phase power line. Power consumption from nominal line is approximately 500 watts for a complete 14 channel record and reproduce system, 450 watts for a 7 channel record/reproduce system. System operation with Precision Frequency Power Supply from 115 v a-c $\pm 10\%$, 48-65 cps, single phase power line consumes 650 watts, maximum at nominal line; from +22 to +26 v d-c power line, consumption is 500 watts, maximum (at +26 v d-c); and from +26 to 32 v d-c power line, consumption is 675 watts, maximum (at +32 v d-c).

DIRECT RECORD / REPRODUCE SYSTEM

Frequency Response and Signal-to-Noise Ratio:

Tape Speed (IPS)	Frequency Response at ± 3 db Points, Referred to 1.0 kc as 0 db	SNR	SNR
		Over Frequency Response Bandwidth Specified	300 cps to Upper Band Edge Specified
60	100 cps to 200 kc	-29 db	-35 db
30	100 cps to 100 kc	-29 db	-35 db
15	100 cps to 50 kc	-29 db	-35 db
7½	100 cps to 25 kc	-28 db	-35 db
3¾	100 cps to 12 kc	-27 db	-35 db
1⅞	100 cps to 6 kc	-25 db	-33 db

Input Level: 1 volt rms nominal (0 db) to produce normal recording level.

Input Sensitivity: 0.25 to 10 volts rms; adjustable with input potentiometer for normal record level.

Input Impedance: 20 k ohms minimum, unbalanced to ground.

Output Level: 1 volt rms nominal (0 db) across a 600 ohm minimum and 3000 micromicrofarads maximum load impedance (at normal recording level).

Output Impedance: Less than 100 ohms unbalanced to ground.

Distortion: 1% $\pm 0.1\%$ 3rd harmonic distortion of a one kc signal and less than .6% intermodulation distortion ($f_1 \pm f_2$ products) when recording and reproducing at normal record level (0 db) at 60 ips.

Bias Frequency: 1.0 MC.

FM RECORD / REPRODUCE SYSTEM

Frequency response, carrier, signal/noise ratio and total harmonic distortion:

Tape Speed (IPS)	Center Frequency (KC)	Information Frequency (KC)	Full-Scale SNR (RMS Signal/ RMS Noise)	Harmonic Distortion (%)
60	108.0	0-20 ± 0.5 db	43 db	1.5
30	54.0	0-10 ± 0.5 db	43 db	1.5
15	27.0	0-5 ± 0.5 db	39 db	1.5
7½	13.5	0-2.5 ± 0.5 db	39 db	1.5
3¾	6.75	0-1.25 ± 0.5 db	36 db	1.5
1⅞	3.375	0-.625 ± 0.5 db	36 db	1.5

Input Level: 1 volt rms nominal (0 db) to produce full scale modulation ($\pm 40\%$ deviation) of the carrier.

Input Sensitivity: 0.5 to 10 volts rms; adjustable with input potentiometer for full scale modulation ($\pm 40\%$ deviation) of the carrier.

Input Impedance: 10 k ohms minimum, unbalanced to ground.

Output Level: 1 volt rms nominal (0 db) across a 10 k ohm load impedance, for full scale modulation.

Termination Impedance: Must work into a 10 k ohm load.

Phase Shift: Linear within 5% of best straight line through d-c for frequencies in the passband.

D-C Linearity: ± 1.5 of full scale, terminal.

A-C Linearity: ± 1.5 of full scale, terminal.

Drift: Less than 2.0% of full scale in an eight-hour period at constant temperature within $\pm 10^\circ\text{F}$.

Transient Response: Adjustable on low pass filter in FM reproduce amplifier for flat frequency response or optimum transient response. Frequency response specified above exhibits high frequency rolloff at approximately ½ band edge frequency when system is adjusted for optimum transient response.

Tape Speed (IPS)	Flat Frequency Rise & Fall Time ($\pm 20\%$)* (μ seconds)	Response Overshoot (Max) (%)	Optimum Rise & Fall Time ($\pm 20\%$)* (μ seconds)	Transient Response Overshoot (Max) (%)
60	17.5	20	22	5
30	35	20	44	5
15	70	20	88	5
7½	140	20	175	5
3¾	280	20	350	5
1⅞	560	20	700	5

*Measured between 10% and 90% points of output pulse amplitude.

PDM RECORD / REPRODUCE SYSTEM

	Tape Speed*	Minimum Pulse Width Covered By Accuracy Spec	Accuracy to 1000 Microsec (Including Jitter)	Accuracy to 10,000 Microsec
Pulse Accuracy including Jitter to 1000 microsec	60 ips	60 μ sec	$\pm 2 \mu$ sec	$\pm 0.2\%$ of pulse width
	30 ips	60 μ sec	$\pm 2 \mu$ sec	$\pm 0.2\%$
	15 ips	100 μ sec	$\pm 5 \mu$ sec	$\pm 0.5\%$
	7½ ips	200 μ sec	$\pm 10 \mu$ sec	$\pm 0.5\%$
	3¾ ips	400 μ sec	$\pm 20 \mu$ sec	$\pm 0.75\%$

*Record and reproduce at the speeds indicated. Operates at 3¾ through 60 ips only.

Input Level: 1 volt peak-to-peak nominal.

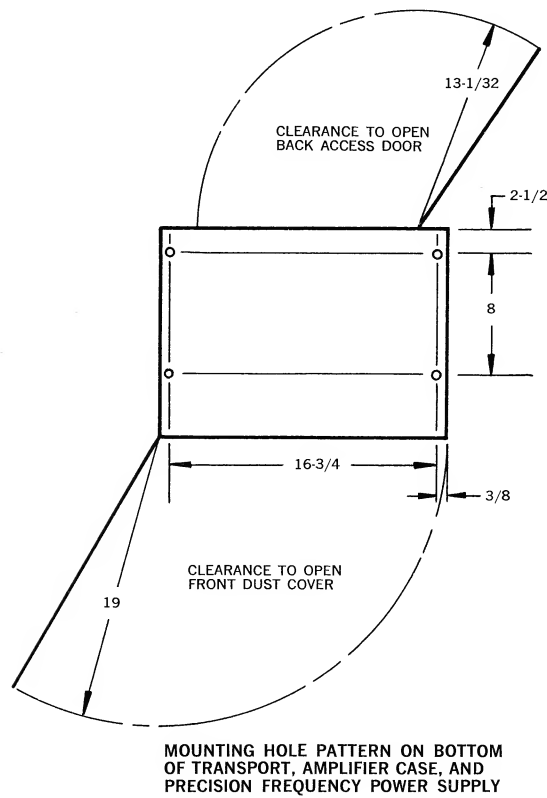
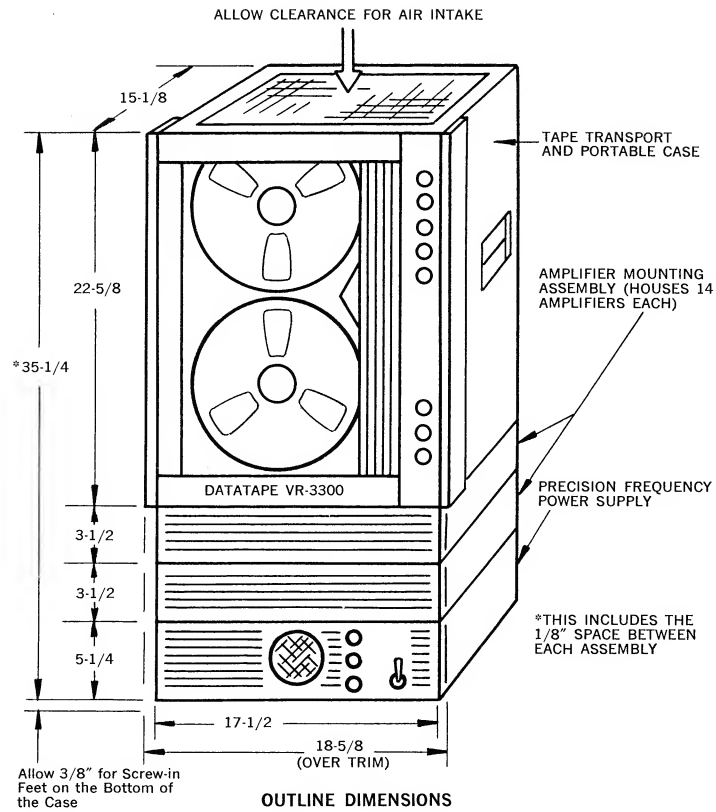
Input Sensitivity: 0.5 volt to 25 volts peak-to-peak, adjustable.

Pulse Rise and Decay Time: 2 microseconds or less.

Input Impedance: 20 k ohms nominal, unbalanced to ground.

Output Level: 8 volts peak-to-peak nominal across a 600 ohm load impedance (0.01 mf maximum capacitance).

Output Impedance: 50 ohms nominal.



SYSTEM OUTLINE VR-3300

PRECISION FREQUENCY POWER SUPPLY

DataTape's Precision Frequency Power Supply is the recommended power source for the recorder/reproducer capstan motor. This is a high-stability power unit that eliminates the effects of variations in line voltage and frequency on the capstan motor and provides a steady tape speed throughout the range of the system. It is required when operation from other than a 115 v a-c, precision 60 cps, single phase power line is desired.

Input:

Voltage: Either 105 to 125 volts a-c, 48-65 cps, single-phase; 210 to 250 volts a-c, 48-65 cps, single-phase; +22 to +26 v d-c or +26 to +32 v d-c (by appropriate plug-in).

Output:

Precision Frequency: 60 cps $\pm 0.01\%$.

Power: Sufficient to drive an entire 14-channel system.

Size: 5 $\frac{1}{8}$ " high x 17 $\frac{1}{2}$ " wide x 16 $\frac{1}{2}$ " deep. The complete unit is furnished with carrying handles, but it may be mounted on heavy duty drawer slides on special order.

REMOTE CONTROL UNIT

The VR-3300 System Remote Control Unit parallels the tape transport RECORD, RECORD INTERLOCK, RUN, WIND (fast forward), REWIND, and STOP mode controls. Its control of the system in these modes is accomplished via an electrical interconnecting cable only. It is suitable for handheld or bench top operation.

Controls: STOP and RECORD INTERLOCK pushbuttons; RECORD, RUN, WIND, and REWIND rocker switches.

Indicators: STOP and RECORD INTERLOCK are back lighted when actuated; pilot lights opposite all other controls indicate mode actuation.

Size and Weight: 2 $\frac{1}{2}$ " high x 6" wide (less connector) x 2 $\frac{1}{4}$ " deep. Weighs less than 5 lbs.

Control Cable: Mating connector provided. VR-3300 System/Remote Control Unit cable, in length desired, available on special order.

TAPE LOOP ADAPTER

The VR-3300 System may be operated as a continuous loop recorder/reproducer system using the CEC tape loop adapter in place of the supply and takeup reels on the tape transport. Units for use with $\frac{1}{2}$ and 1" tape widths are available as standard.

Tape Capacity: Any loop length from 4 to 75 feet. Tape is visible through a clear window on the loop adapter.

Flutter: VR-3300 flutter (and related system performance) is degraded by 50%, maximum, when using the loop adapter.

Tape Life: 1000 passes across the heads, minimum using CEC recommended tape.

Size and Weight: The Loop Adapter measures approximately 19" long x 10" wide x tape width + $\frac{1}{2}$ " deep and weighs approximately 6 lbs.

NOTE: All specifications shown on this and the preceding page are subject to change without notice. All specifications based on using standard CEC test procedures.

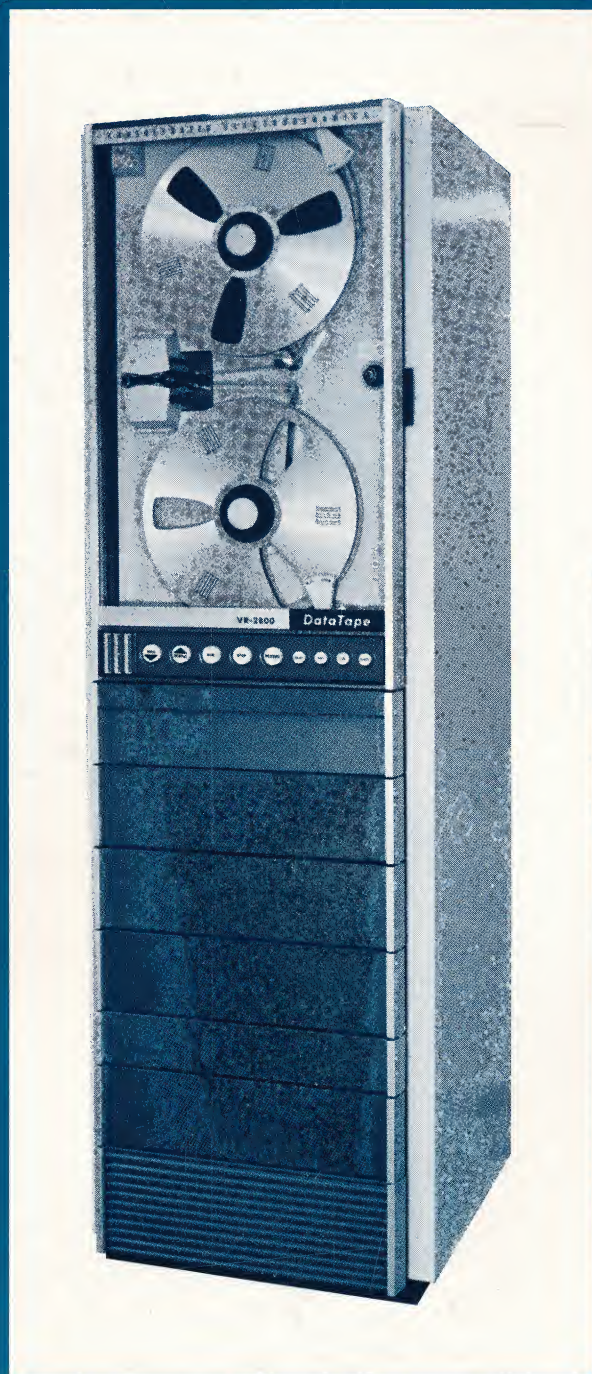
DATA RECORDERS DIVISION

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VR-2800 MAGNETIC TAPE RECORDER/REPRODUCER



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DATA RECORDERS DIVISION

CONSOLIDATED ELECTRODYNAMICS / A SUBSIDIARY OF
BELL & HOWELL

VR-2800 MAGNETIC TAPE RECORDER/REPRODUCER

DESCRIPTION

Consolidated's VR-2800 Magnetic Tape Recorder/Reproducer is a wideband system for use in laboratory environments with direct, FM, and PDM electronics. Bandwidth of direct recording/reproducing is 100 cps to 200 kc; 0 to 20 kc with wideband FM techniques and per IRIG capacities specified for PDM channels. This represents twice the bandwidth capability of conventional machines at equivalent speeds. Thus, the VR-2800 can do the recording job of two conventional recorders—using 14-inch reels of 1.0 to 1.5 mil tape.

Compact, solid-state design of the VR-2800 permits packaging the full 14-channel system and accessories in a single six-foot EMA cabinet. Six standard recording speeds in three pairs are available, with electrical selection in each pair by pushbutton controls. The versatile and reliable VR-2800 operates on minimum power and with minimum maintenance. Standard features include closed-loop capstan drive, tape tension control via mag-amp driven reel motors (on both reels), interchangeable plug-in solid-state electronics, fail-safe mechanical brakes, and IRIG or FM servo speed control. A design feature of the VR-2800 is provision for accessories of "building blocks," such as precision capstan drive electronics, loop adapter, monitor meters or oscilloscopes, signal attenuators, and other accessories as required for the application.

FEATURES

Complete Front Accessibility

All internal components of the VR-2800 are accessible from the front of the instrument. Included are amplifier gain and calibration controls. Equalization networks (dual speed) plug in from the front of the direct reproduce amplifier via a printed circuit connector.

The unit's entire transport assembly swings out on a heavy-duty hinge and locks open. A transparent dust cover protects tape and mechanical components without covering operating controls. Electrical chassis are mounted on drawer slides, permitting individual chassis to be pulled out for recorder setup, signal connection, adjustment, and maintenance. When permanently anchored, the entire system can operate with drawer units and transport open—allowing simultaneous physical inspection and dynamic testing.

One-Piece Transport Base Plate

Mechanical components of the VR-2800 transport are fixed in a precise alignment on a single-piece mounting base of one-inch-thick aluminum casting. Multiple heat treating of the base plate casting during manufacture insures long-term dimensional stability. A precision-flat plate is used for mounting of all magnetic heads, capstan, and associated vital tape drive components—for constant dimensional accuracy and stability such that specified performance can be achieved even after years of utilization.

Tape Speeds

Six standard tape speeds in 3 pairs (60, 30 ips; 15, 7½ ips; and 3¾, 1⅞ ips) are set by means of a belt and switch position change. Selection of either speed in the pairs indicated is made with high-low pushbuttons on the front panel. Highest speed accuracy and stability are achieved when using the recommended power source for the VR-2800 transport capstan motor; the Capstan Power Amplifier, and either the Precision 60 cps Generator or the Precision Multifrequency Generator. Both assemblies are high accuracy, high stability power units that eliminate the effects of variations in the main power line on the tape drive system and provide a steady tape speed with minimum flutter throughout the range of the system.

The VR-2800's Tape Speed Control Servo compensates for low frequency variations in tape speed introduced between recording and reproducing. Its use will provide average tape speed accuracy during reproduce that is within $\pm 0.02\%$ of the recorded tape speed. All operating power and signal connections are accommodated within the Capstan Power Amplifier, into which the servo is installed.

The CEC Tape Speed Control Servo can be utilized with either IRIG (60 cps amplitude modulated 17.0 kc) or FM carried 60 cps composite reference signals by changing a plug-in. The FM system provides servo control (during playback) for a tape recorded at any speed at the same or any other standard speed wherein a composite reference frequency signal has been recorded. Such a composite signal must contain a 60 cps signal during playback for operation of the servo.

Tape Widths

The tape transport of the VR-2800 accepts tape widths of ½ or 1 inch wide 1.0 or 1.5 mil mylar or acetate base tape. Reel sizes of 14 inches in diameter with EIA hubs are accommodated.

Flutter

The VR-2800's closed loop capstan drive system, in conjunction with the magnetic amplifier tension control system, provides the lowest flutter of any machine in its class.

All-Metal Surface Magnetic Heads

Magnetic record and reproduce heads of the VR-2800 feature precision construction and long-life characteristics. All-metal front-surface magnetic head stack construction is used exclusively. The finely honed and hard surface of the head stack minimizes oxide buildup and wear, resulting in low separation losses between tape and head, of particular importance in high frequency direct recording-reproducing systems. Head stacks mount directly on a flat precision plate, with no shims, adjustments, or special tools or procedures needed. Standard CEC head stacks for seven and fourteen track configurations are standard; others are available on special order.

FEATURES

Wide Bandwidth

Six Speed Operation

Plug-in Electronics (Solid-State)

Closed Loop Capstan Drive

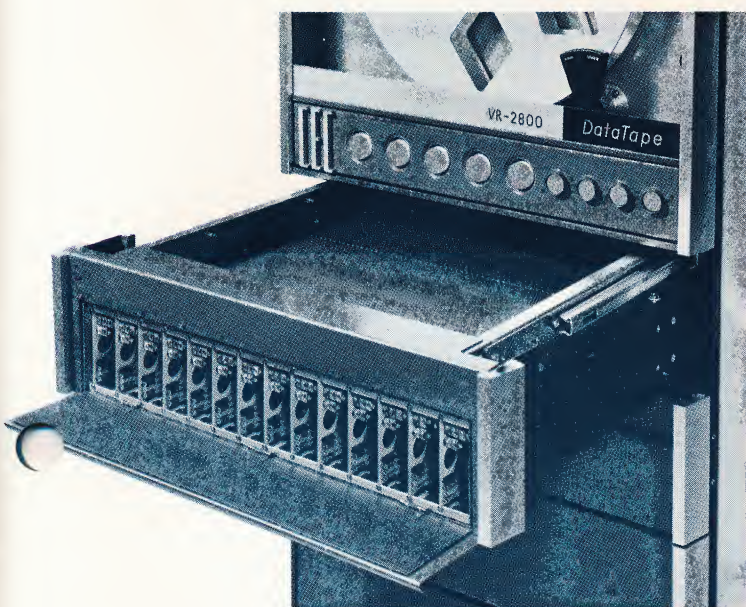
All Metal Surface Magnetic Heads

Complete Front Access

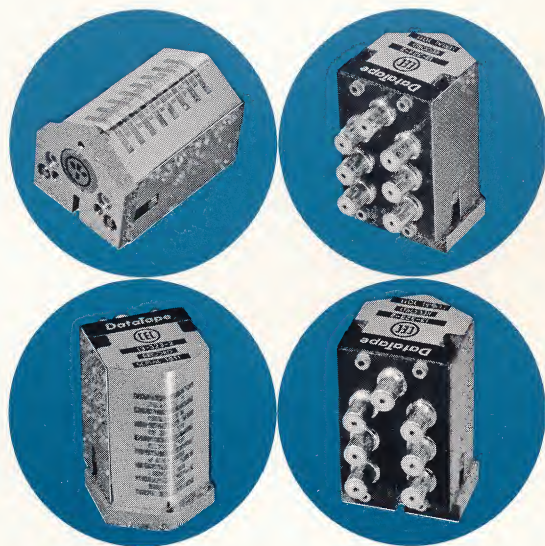
Fail-safe Mechanical Brakes

Automatic Tape Stop

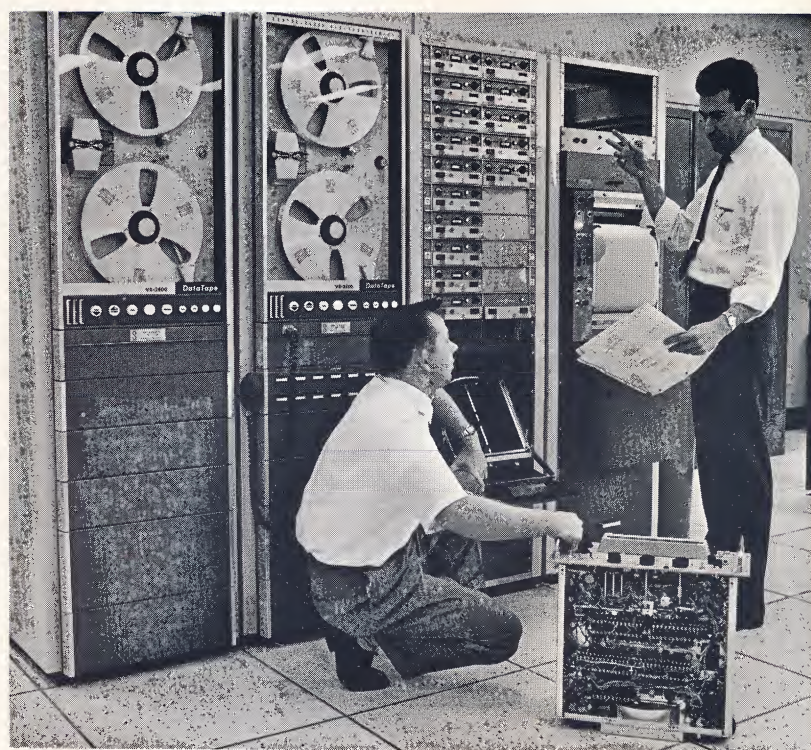
IRIG or FM Servo Speed Control



Above, fourteen amplifier cards, protected by a drop-down door, are contained in one drawer, which is shown extended. Cards are easily removed or exchanged.



VR-2800 RECORDING TIME:		
TAPE SPEED	FREQUENCY RANGE (MAX)	
	DIRECT ELECTR.	FM ELECTR.
60 ips	.1 to 200 kc	d-c — 20 kc
30 ips	.1 to 100 kc	d-c — 10 kc
15 ips	.1 to 50 kc	d-c — 5 kc
7-1/2 ips	.1 to 25 kc	d-c — 2.5 kc
3-3/4 ips	.1 to 12 kc	d-c — 1.25 kc
1-7/8 ips	.1 to 6 kc	d-c — .625 kc



Above, the two VR-2800 Magnetic Tape Recorder/Reproducers, above, are an integral part of the Analog Computer Facility at Ford Motor Company's Aeronutronic Division. Research laboratory computes statistical analyses on power spectral densities, power spectral analysis, shock spectra, Fourier analysis, and computation of Root Mean Square (RMS).

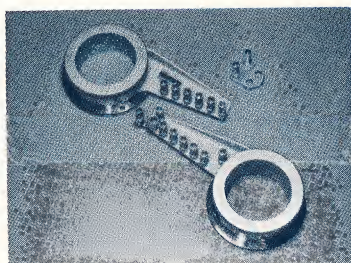
Left, CEC's new precision, long-life magnetic heads feature a newly designed face configuration. Higher unit-area tape pressure results in radical reduction of dropouts; improved output characteristics, especially at high frequencies; greater track-to-track uniformity. The new heads are in accordance with applicable paragraphs of IRIG Specification 106-60.

RECORDING TIME			
10½ INCH REEL		14 INCH REEL	
1.0 MIL TAPE	1.5 MIL TAPE	1.0 MIL TAPE	1.5 MIL TAPE
12 min.	8 min.	24 min.	16 min.
24 min.	16 min.	48 min.	32 min.
48 min.	32 min.	1 hr. 36 min.	1 hr. 4 min.
1 hr. 36 min.	1 hr. 4 min.	3 hr. 12 min.	2 hr. 8 min.
3 hr. 12 min.	2 hr. 8 min.	6 hr. 24 min.	4 hr. 16 min.
6 hr. 24 min.	4 hr. 16 min.	12 hr. 48 min.	8 hr. 32 min.

ACCESSORIES AVAILABLE

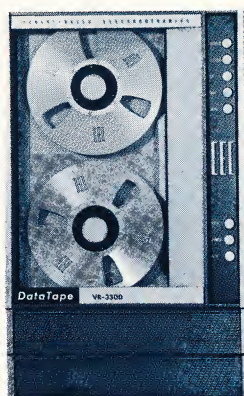
Magnetic-Head Track Patch Panel
 Remote Control Unit
 Magnetic-Head-Track-Switch Panel
 Signal Monitor Meters and Attenuators
 for Record and Reproduce Amplifiers
 Input/Output Signal Patch Panel
 Dolly Mounts
 Tape Loop Adapters

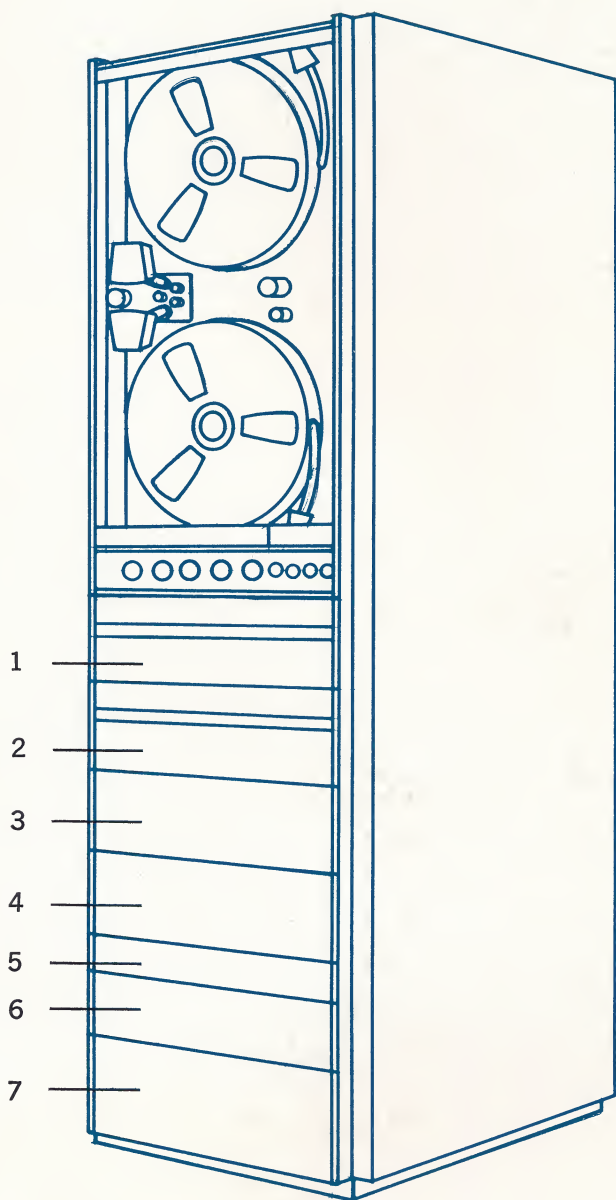
Tape loop adapters, available as accessories, convert the VR-2800 to a continuous loop recorder/reproducer. Adapters are easily installed and removed.



Automatic Tape Degausser bulk erases ½ inch and 1 inch magnetic tape to a nominal 90 db below saturation level; accepts reels from 7 to 14 inches in diameter and tape widths from ¼-inch to 2-inch television tapes. Degausser is available for bench or rack mount. Bulletin 2903.

Amplifier cards used in the Type VR-2800 can also be used in CEC's Type VR-3300 Portable Recorder/Reproducer. Bulletin 3300V.



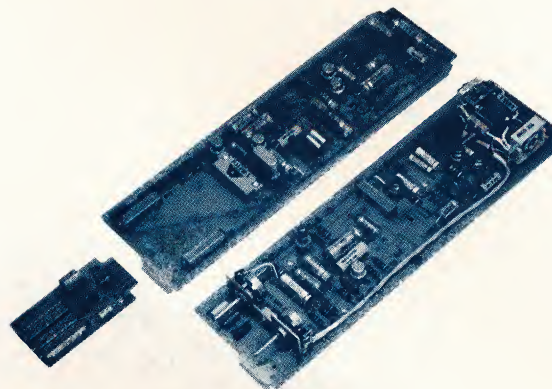


1. 14 Amplifiers
2. 14 Amplifiers
3. Blank
4. Blank
5. Blank
6. CPA, PFG and Servo
7. Grill

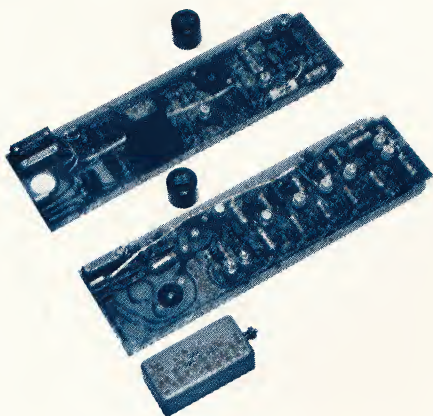
RECORD AND REPRODUCE AMPLIFIERS

Plug-in record and reproduce amplifiers for the VR-2800 are available for Direct, FM, and PDM modes of operation. These all solid-state electronics, interchangeable with those in CEC's VR-3300 system, provide high reliability and versatility consistent with low power consumption and physical size. Amplifiers are identical in size, permitting them to be interchanged freely for different system utilization. Circuit construction utilizes copper-clad epoxy-fiber glass laminate circuit boards. Electronic components are overrated to insure long life.

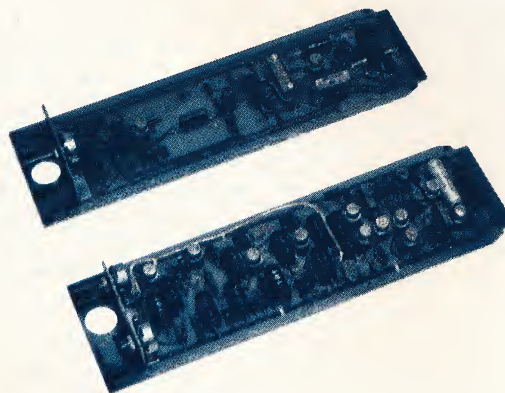
Inputs and outputs are terminated at standard BNC connectors at the rear of each amplifier mounting assembly. Electrical access to internal test points is made through test jacks on the front of each amplifier card. Meters, oscilloscopes, and other test instruments can be plugged into the test jacks for adjustment and monitoring.



Direct Record and Reproduce Amplifiers with plug-in equalizer



*FM Record and Reproduce Amplifiers
with plug-in center frequency networks and filter*



PDM Record and Reproduce Amplifiers

NOTE: All specifications subject to change without notice. All specifications based on using standard CEC test procedures.

CONSOLIDATED ELECTRODYNAMICS
DATA RECORDERS DIVISION • 360 SIERRA MADRE VILLA, PASADENA, CALIFORNIA 91109
A SUBSIDIARY OF BELL & HOWELL • FINER PRODUCTS THROUGH IMAGINATION

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Suite 205
635-1600

Arlington, Virginia
2009 - 14th St. North
524-3151

Columbus, Ohio
1350 West Fifth Ave.
488-9781

Dallas, Texas
433 Regal Row
MEIrose 1-3700

Des Plaines, Ill.
3150 Des Plaines Ave.
299-7751

Hampton, Va.
1120 W. Mercury Blvd.
838-2455

Hasbrouck Heights, N.J.
345 Boulevard
ATlas 8-2055

Houston, Texas
Suite 4, 5405 Griggs Rd.
OLive 4-5767

Huntsville, Alabama
3322 S. Memorial Pkwy.
881-2231

Los Altos, California
900 N. San Antonio Rd.
948-8294

Needham Heights, Mass.
45 Fourth Ave.
444-8010

New Orleans, La.
1025 S. Jefferson Davis
Pkwy.
482-3152

Philadelphia, Pa.
2010 Oregon Ave.
HHoward 5-3773

Pomona, California
675 No. Park Ave.
NAtional 3-1487

Salt Lake City, Utah
48 East Robert Ave.
486-9297

Seattle, Washington
302 Second Ave., West
ATwater 4-5370

St. Louis, Missouri
1401 Brentwood Blvd.
WOOdland 2-3542

Syracuse, New York
Pickard Bldg., Room 104
E. Molloy Road
454-9292

Van Nuys, California
Suite 314
5430 Van Nuys Blvd.
872-2960

Winter Park, Florida
501 Park Avenue North
Midway 7-0101

CEC/GmbH
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West Germany

**Consolidated
Electrodynamics Division**
14 Commercial Rd.
Woking, Surrey, England
Woking 5633

GENERAL SPECIFICATIONS

VR-2800 MAGNETIC TAPE RECORDER / REPRODUCER SYSTEM

TRANSPORT

Tape Speeds: Six standard speeds in 3 pairs (60, 30); (15, 7½); (¾, 1⅞) inches per second are set up by means of a simple belt and switch position change. HIGH-LOW pushbuttons on the transport front panel permit electrical selection of either speed in the pairs indicated.

Tape Speed Accuracy: (for periods longer than 1 second) $\pm 0.2\%$ (with capstan motor operated from CEC Capstan Power Amplifier and Precision 60 cps Generator or Precision Multifrequency Generator, or equal power source).

Tape: ½- or 1-inch wide 1.0 or 1.5 mil mylar or acetate base tape (¼ inch on special order, specifications on request).

Reels Accommodated: Any reel size up to 14 inches in diameter with EIA hub. All specifications are based on use of CEC precision reels and CEC recommended tape. CEC precision reels are supplied as standard equipment.

Controls: Backlighted pushbuttons on waist level control panel for: WIND, REWIND, STOP, RUN, RECORD, MAIN POWER, HIGH & LOW (Tape Speed Selectors). Remote control of WIND, REWIND, RUN, RECORD, and STOP are accommodated by connection of a cable at the tape transport and use of a CEC remote control unit, or equivalent. A ready light indicates that the transport is ready to operate.

Start, Stop, and Rewind Times: (115 v a-c power) Wind and Rewind speeds are nominally the same. A full 14-inch reel of 1.5 mil base tape (4800 feet) can be shuttled in approximately 4.0 minutes. Actuation of RUN mode will provide starting within 3.0 seconds at 60 ips or lower speeds. Tape can be stopped in less than 2.0 seconds from all capstan controlled speeds.

Flutter:* Maximum cumulative peak-to-peak flutter:

Tape Speed	% Flutter	Passband
60	0.25	.2 cps-10 KC
30	0.30	.2 cps-5 KC
15	0.40	.2 cps-2.5 KC
7½	0.60	.2 cps-1.25 KC
¾	0.60	.2 cps-625 cps
1⅞	0.70	.2 cps-312 cps

*When using CEC Capstan Power Amplifier and Precision Frequency Generator for record and reproduce, or equivalent power source.

Fail Safe: Transport stops if tape breaks or if power fails without spilling tape. Cut-off switches are provided to prevent operation with loading arms in loading position. A time delay in STOP is provided to prevent tape damage in going from WIND or REWIND through STOP to RUN.

Automatic Stop: Automatic STOP is provided when using 50 feet of conductive tape leader on 10½ inch reels or 75 feet of conductive leader on 14 inch reels from any tape speed of 60 ips or below.

SYSTEM

Environment: The system has been designed for use in a laboratory environment where shock, vibration, salt atmosphere, and sand and dust are not encountered. The equipment has been found suitable for use in trailer installations while stationary and on shipboard where laboratory conditions are maintained. The equipment is transportable in trailers when suitably mounted and packaged.

Operating Power Requirements: Power consumption from 105 to 125 v RMS, 60 cps a-c, single phase power line is approximately 1300 watts for a seven channel direct record/reproduce system, including CPA, and 1400 watts for a fourteen channel direct record/reproduce system, including CPA.

Finish: The cabinet and transport are pearl gray (almost white) with charcoal metallic gray panels, blue control panel, black trim (transport frame and base), and aluminum vertical trim.

Cables & Connectors: All signal input and output connectors are BNC type, mounted on the rear of electronics mounting assemblies. Signal cable entry holes at the bottom rear of the cabinet are provided. Input power connection is via a Hubbel Twist Lock three prong polarized connector mounted at the bottom rear of the cabinet. A Power and Control Connector Panel on the rear of the transport (accessible from the front) is provided for remote control connections.

MAGNETIC HEADS

Number of Tracks: 7, 4, and 3 in standard head stacks. Transport accommodates 4 head stacks for record and reproduce. 14-channel operation requires two 7-track stacks (interleaved) on 1-inch tape (1 set for record, 1 set for reproduce). 7-channel operation requires one 4-track stack and one 3-track stack (interleaved) on ½ inch tape (1 set for record, 1 set for reproduce).

Track Width: 0.050" ± 0.002 ".

Track Spacing: 0.070" ± 0.002 " center-to-center (interleaved stacks). 0.140" ± 0.002 " center-to-center (single stack).

Gap Azimuth Alignment: $90^\circ \pm 1$ minute of arc to the base.

Gap Scatter: ± 50 microinches.

Electrical Connection: Individual connector for each head track located on the back of the head stack. Double shielded coaxial cable with mating connectors supplied separately or with a system for each head track to be utilized.

Mounting: Head stacks mount on a flat precision plate which is fixed to the baseplate of the transport. Head stacks are located by means of two precision dowel pins and two hold down screws. Head stacks are interchangeable without shims or adjustment.

Dummy Head Stacks: Dummy head stacks are required when operating with one or more active head stacks removed. No electrical connection is made to dummy head stacks. The function of dummy head stacks is to provide the proper tape wrap angle on the capstan and active head stacks.

DIRECT RECORD / REPRODUCE SYSTEM

Frequency Response and Signal/Noise Ratio

Tape Speeds (IPS)	60	30	15	7½	3¾	1⅞
Frequency Response (Referred to 1.0 KC)	± 3 db	± 3 db	± 3 db	± 3 db	± 3 db	± 3 db
Bandwidth Measured	100 cps to 200 KC	100 cps to 100 KC	100 cps to 50 KC	100 cps to 25 KC	100 cps to 12 KC	100 cps to 6 KC
S/N (RMS Signal to RMS Noise) over Bandwidth stated above	29 db	29 db	29 db	28 db	27 db	25 db
300 cps to upper band edge specified	35 db	35 db	35 db	35 db	35 db	33 db

Input Level: 1.0 v RMS nominal (0 db) for normal record level.

Input Sensitivity: 0.25 to 10.0 v RMS adjustable with input potentiometer for normal record level. ($1.0 \pm 0.1\%$ third harmonic distortion).

Input Impedance: 20K ohms minimum, unbalanced to ground.

Output Impedance: Less than 100 ohms, unbalanced to ground from 100 cps to 200 KC.

Output Level and Load: 1.0 v RMS into 600 ohm min and 3000 μ f (max load) at normal record level, unbalanced to ground.

Distortion: 1% $\pm 0.1\%$ third harmonic distortion of a 1 KC signal and less than 0.6% intermodulation distortion ($F_1 \pm F_2$ products) when recording and reproducing at normal record level (0 db) at 60 ips.

Bias Frequency: 1.0 MC

Controls: Front of amplifier controls for record and bias level settings on record amplifier and gain and dual speed equalization controls on reproduce amplifier. Monitor jacks allow monitoring of record head current on record amplifier and output signal on reproduce amplifier.

FM RECORD / REPRODUCE SYSTEM

Frequency Response, Carrier Center Frequency, SNR & Distortion

Tape Speed (IPS)	Center Frequency (KC)	Information Frequency (KC)	Signal/Noise Ratio (RMS Signal/RMS Noise)	Total Harmonic Distortion (%)
60	108.0	0-20 ± 0.5 db	45 db	1.5
30	54.0	0-10 ± 0.5 db	45 db	1.5
15	27.0	0-5 ± 0.5 db	41 db	1.5
7½	13.5	0-2.5 ± 0.5 db	41 db	1.5
3¾	6.75	0-1.25 ± 0.5 db	38 db	1.5
1⅞	3.375	0-.625 ± 0.5 db	38 db	1.5

Input Level: 1.0 v RMS nominal (0 db) to produce full scale modulation of the carrier.

Input Sensitivity: 0.5 to 10.0 v RMS adjustable with input potentiometer for full scale modulation ($\pm 40\%$ deviation).

Input Impedance: 10K ohms, nominal, unbalanced to ground.

Output Level: 1.0 v RMS, across a 10K ohm load impedance, unbalanced to ground, for full scale modulation.

Termination Impedance: Must work into 10K ohm load.

A-C Linearity: $\pm 1.5\%$ of full scale, terminal.

D-C Linearity: $\pm 1.5\%$ of full scale, terminal.

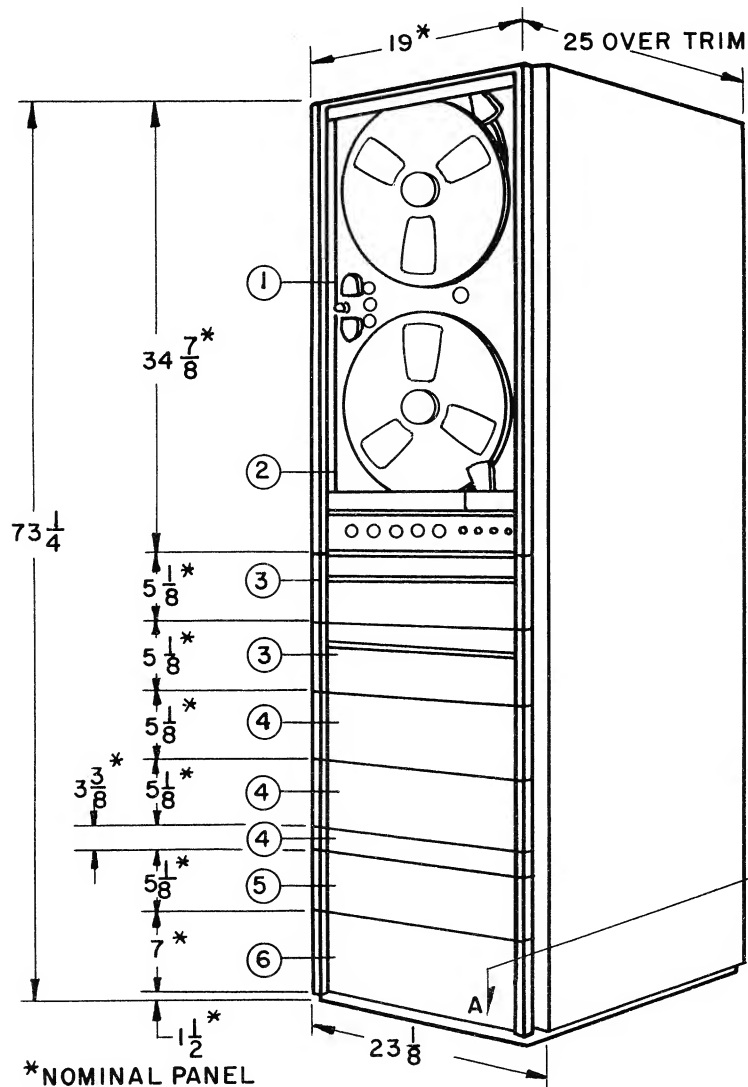
Drift: Less than 2.0% of full scale in an eight-hour period at constant temperature within $\pm 10^\circ$ F.

Transient Response: * (Adjustable on Low Pass Filters)

Tape Speed (IPS)	Flat Frequency Response		Optimum Transient Response	
	Rise & Fall Time ($\pm 20\%$) (μ sec)	Overshoot Maximum (%)	Rise & Fall Time ($\pm 20\%$) (μ sec)	Overshoot Maximum (%)
60	17.5	20	22	5.0
30	35	20	44	5.0
15	70	20	88	5.0
7½	140	20	175	5.0
3¾	280	20	350	5.0
1⅞	560	20	700	5.0

*Rise and Fall Times measured between 10% and 90% of output pulse amplitude.

Phase Linearity: Within 5% of B.S.L. through d-c for all frequencies in the passband (exclusive of phase shift associated with time delay from record to reproduce operation).



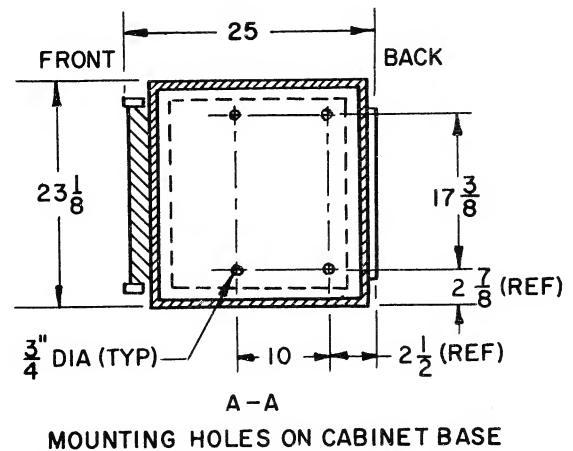
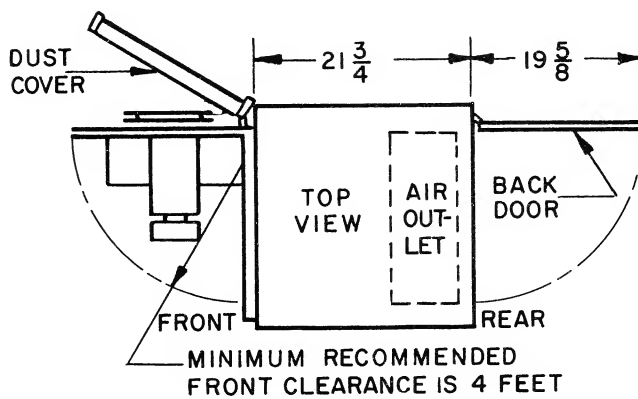
- ① TAPE TRANSPORT
- ② DUST COVER
- ③ AMPLIFIER MOUNTING ASSEMBLY (HOUSES 14 AMPLIFIERS)
- ④ SPARE COMPARTMENT (USED FOR ACCESSORIES ON CUSTOM ORDERS)
- ⑤ CAPSTAN POWER AMPLIFIER, PRECISION FREQUENCY GENERATOR, AND TAPE SPEED CONTROL SERVO.
- ⑥ AIR INLET AND FILTER

WEIGHT:

TYPICAL 14 CHANNEL, SINGLE CABINET RECORD/REPRODUCE SYSTEM - APPROX. 750 POUNDS

TYPICAL 7 CHANNEL, SINGLE CABINET RECORD/REPRODUCE SYSTEM - APPROX. 700 POUNDS

*NOMINAL PANEL DIMENSIONS
ALL DIMENSIONS IN INCHES



VR-2800 OUTLINE DIMENSIONS*

PDM RECORD AND REPRODUCE SYSTEM

Pulse Width Accuracy, including jitter — Record & Reproduce at the Speeds Indicated

Tape Speed (IPS)	Minimum Pulse Width	Accuracy to 1000 Microsec	Accuracy to 10,000 Microsec (% of Pulse Width)
	Covered by Accuracy Spec.		
60	60 μ sec	± 2 μ sec	± 0.2
30	60 μ sec	± 2 μ sec	± 0.2
15	100 μ sec	± 5 μ sec	± 0.5
7½	200 μ sec	± 10 μ sec	± 0.5
3¾	400 μ sec	± 20 μ sec	± 0.75

Input Level: 1 volt peak-to-peak nominal

Input Sensitivity: 0.5 volt to 25 volts peak-to-peak, adjustable to produce standard record level

Pulse Rise and Decay Time: 2 microseconds or less

Input Impedance: 20K ohms, nominal, unbalanced to ground

Output Level: 8.0 volts peak-to-peak, nominal across a 600 ohm load impedance (0.01 μ f maximum capacitance)

Output Impedance: 50 ohms, nominal

CAPSTAN DRIVE ELECTRONICS

The Capstan Power Amplifier and its included Precision 60 cps Generator or accessory Precision Multifrequency Generator is the recommended power source for the transport capstan motor. This assembly is a high accuracy, high stability power unit that eliminates the effects of variations in the main power line on the tape drive system and provides a steady tape speed with minimum flutter throughout the range of the system.

Output: Precision 60 cps to capstan motor: 210 v p-p square wave (min). Precision 60 cps square wave to drive record electronics for servo reference recording: 10 v p-p $\pm 20\%$ into 10K ohms, unbalanced to ground (obtained from same source used to provide precision 60 cps to capstan motor). Composite Output (only if Precision Multifrequency Generator is used): 1 v p-p $\pm 20\%$ into 10K ohms, unbalanced to ground (for recording via an FM record amplifier for subsequent playback and servo control at any transport speed).

Frequency: Precision 60 cps Generator: 60 cps $\pm 0.01\%$ (0 to 50°C). Precision Multifrequency Generator: 60 cps for capstan drive and 3.84 KC, 1.92 KC, 960 cps, 480 cps, 240 cps, 120 cps, 60 cps, 30 cps, 15 cps, 7.5 cps, 3.75 cps, 1.875 cps, and 0.9385 cps, linearly mixed.

Input Signals: External Reference: 2.5 v RMS minimum into 510 ohms, 55 to 60 cps. (To Capstan Power Amplifier.)

Servo Input: (From reproduce amplifier output) 1.0 v RMS $\pm 20\%$ into 10K ohms, unbalanced to ground.

Fail Safe: Capstan Power Amplifier failure reverts capstan power source to an external source (may be connected to power line). When mode selector is in line position, the capstan motor is also connected to this external source.

Indicators: Power ON, warning of high temperature indicates blower filter needs cleaning, fail safe indicator-lights in "line" position or when power amplifier fails.

An accessory Tape Speed Control Servo, installed in the Capstan Power Amplifier, compensates for low frequency variations in the tape speed introduced between recording and reproducing. All operating power and signal connections are accommodated within the Capstan Power Amplifier into which the servo is installed. Operation from IRIG 17.0 KC or 18.24 KC Reference Carrier is accommodated by change of a plug-in filter. Fail safe circuit reverts transport drive power to Precision Power if servo reference signal is lost.

This servo, which provides for recording and playing back at the same speed using a 17.0 KC or 18.24 KC AM reference signal (for tape speeds of 60, 30, 15, and 7½ ips) is also utilized, with change of a plug-in unit, for playing back a tape recorded at any speed, at the same or any other standard speed wherein a composite reference frequency (including multiples and submultiples of 60 cps) has been recorded. Such a composite signal must contain a 60 cps signal during playback for operation of the servo. Servo reference recording reproducing requires a single FM channel in this system.

ACCESSORIES

Monitor Oscilloscopes: All solid-state circuitry Monitor Oscilloscopes provide visual monitoring of system input and/or output signals on a multichannel basis. Seven plug-in monitor "scopes" are accommodated in a slide mounted chassis, including power supply.

Tape Loop Adapter: The CEC tape loop adapter quickly adapts the VR-2800 system for use in a continuous loop application. There is no change in system specifications except for an instantaneous periodic flutter transient which occurs when the splice passes across the heads. Various loop lengths from 2 to greater than 19.5 feet are accommodated.

Other accessories include cabinet dolly, remote control unit, Automatic Tape Degausser, and modifications for special applications.

NOTE: All specifications subject to change without notice. All specifications based on using standard CEC test procedures.

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